WOODLOT MANAGEMENT
HOME STUDY COURSE

MODULE 3
STAND SPACING

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LESSON NO. 1

CLEANING

Definition:

Cleaning is a spacing treatment carried out in young natural stands (Figure 1). It involves the removal of undesirable competition during the sapling stage of stand development to release the better quality, desirable trees.

STANDS TO CLEAN

Stands that are suitable for cleaning would have the following characteristics:

1) Young thickets of softwood or mixedwood saplings.

2) The stand should be young, usually not over 20 years old.

3) The average height should be between 2 m (6') and 6 m (20') tall.

4) Dense enough that the crowns of the trees are interfering with each other, therefore, causing slow diameter growth. These would be stands that have more than or equal to 10,000 trees/hectare (4,000/ac).

5) The stand should be greater than 60% stocked. You will remember from Module 1 - lesson 4 - that this is the same as saying that more than 60% of the available growing space should be occupied by trees.

6) The site capability should be a class 4 or better. That means that the site should be able to produce at least 4 cu m/ha/yr (0.7 cd/ac/yr), in order to get a reasonable growth response.

7) The general condition of the trees must be healthy. There must be enough, healthy, vigorous trees to form the residual crop after the cleaning.

During the early period of stand development, the rate of crown and therefore diameter growth is increasing. This crowding results in side competition which reduces diameter growth. To prevent this,

FIGURE 1

TYPICAL STAND TO CLEAN

cleaning should remove undesirable trees such as those that are diseased, damaged and/or unwanted species.

The result of cleaning is to reduce competition to the point of maintaining vigorous growth and/or increase diameter growth. Contrary to popular belief, cleaning has very little effect on height growth.

Removal of too much competition can result in the development of excessively limby trees. For example, open grown hardwoods tend to develop into limby trees. These hardwood stands should not be cleaned until they are pole size.

EXPECTED GAINS FROM CLEANING

There are certain gains to be expected from cleaning young suitable stands. These gains are:

1) To increase the merchantable yield of the stand.

2) To increase the rate of diameter growth on the remaining trees and thus reduce the time between harvests.

3) To reduce the amount of small diameter trees at harvest.

4) To reduce harvest cost by producing the same volume on fewer trees.

5) To develop better, stronger crowns and root systems, making the stand more wind and snow resistant.

6) To allow you to favourably adjust the species composition.

It is important to clean a new stand as early in the sapling stage as possible for the following reasons:

1) To avoid the loss of desirable species as a result of faster initial growth of less desirable species.

2) To maximize diameter growth.

3) To minimize mechanical damage to crop trees from whipping

4) To maximize crown and root development.

The main advantage of cleaning is to reduce the time to grow merchantable wood. Without spacing, trees will severely compete with each other for light and nutrients. Over time the number of trees will be reduced as some trees die out because of competition. As these trees die out the remaining trees are freed to develop into crop trees. With spacing, this reduction in the number of trees takes place over a very short period of time and thus the crop trees are freed to grow at an earlier age. As a result the crop trees reach merchantable size sooner. The crop trees will have utilized the available growing space and be ready for cutting when the average diameter of the trees in cm is equal to the average spacing between crop trees in metres.

For example, on a site class 5 spacing the crop trees 1.8m x 1.8m (6' x 6') will produce a fully stocked stand with an average diameter of 15cm (6") at age 40. It would take approximately 10 years longer to produce these conditions if the stand had not been cleaned.

It is important at this stage of the course for you to be aware that to get the maximum volume growth from a stand, you must continue to manage the stand throughout its development. That is, you will have to follow the cleaning with future spacings, called thinnings.

HOW TO DO A CLEANING

Once you have determined that a stand is suitable for cleaning, there are a number of things to do before you cut the first tree. Remember that once a tree is cut there is no going back. Therefore, put time and thought into planning your job. You won't regret it!

1) Select Crop Trees:

Your first concern is which trees are desirable. In other words, decide first which trees are to be left. As mentioned earlier, only select the better quality, undamaged, vigorous trees to leave as your future crop trees. The more difficult task is deciding which species to favour. Generally speaking, in softwood and mixedwood stands favour spruce and white pine over balsam fir and favour the tolerant hardwoods such as sugar maple or yellow birch over intolerant hardwoods

such as white birch, aspen, pin cherry and grey birch. Whenever possible try to leave a slight mix in species (e.g. leave 10% to 15% hardwoods). Where there is no hardwood component (e.g white spruce on old pastures) leave some softwoods other than the species that has been selected for the crop trees. By maintaining a slight variety in species cover you will provide food and habitat for a variety of wildlife species that will bring you many years of enjoyment.

Undesirable trees which are to be cut are the poorer quality trees in the stand. They would be trees that have double leaders, are scarred by porcupines, diseased or dead, broken, or are large trees that have been left from previous cutting.

2) Determine Spacing and Stocking:

The next task in planning your cleaning is to determine the spacing best suited to your conditions. From a biological point of view, the distance to leave between the chosen crop trees is based for the most part on the quality of the site. On good quality sites individual trees can utilize more growing space than on poorer sites in the same period of time. They grow faster! For spacing distances by site see the following list:

Site Class	Recommended Spacing	Trees left after Thinning
4 & 5	1.8m x 1.8m (6' x 6')	3,000/ha (1,200/ac)
6 & 7	1.8m x 1.8 to 2.4m x 2.4m (6'x6'to 8'x8')	3,000/ha 1,700/ha (1,200 - 680/ac)
8 & 9	1.8m x 1.8m to 3.0m x 3.0m (6'x6' to 10'x10')	3,000/ha 1,100/ha (1,200 - 440/ac)

These distances are averages. For example, on a site class 4 and 5 it is acceptable to have the remaining trees from 1.5m (5') to 2.1m (7') apart. Try to be as consistent as the stand conditions allow and work towards an even distribution of the remaining trees. If in doubt about the spacing, contact someone trained in forestry for advice.

Once you have chosen the stand to be cleaned, the species to leave and have determined the best spacing,

you are ready to take saw in hand.

3) Treatment Layout:

In order to efficiently cover the area to be treated and to organize the job, it is best to divide the area to be treated into workable size strips. While a recommended strip width is 40 m to 50m (130 - 165 ft), use a strip width that is convenient for you to work.Run your strip lines from roads where possible, using a compass or sighting on a distant tree or land mark. The strips can be marked with string on small jobs and with flagging tape on the larger jobs. Start the cleaning in one corner of the stand, complete one strip then come back down the adjacent strip (Figure 2) and so on. By organizing the work this way you will avoid walking in slash and increase your efficiency. When working on steep slopes start at the bottom and work up the slope.

4) Checking Spacing and Stocking:

To achieve the desired results, it is important to periodically check your spacing. Remember that you are trying to get consistent correct spacing throughout the stand. The spacing is too important to try to assess by eye. It must be measured. An easy way to judge spacing is to spread your arms out at shoulder height. The distance between the finger tips of your hands is roughly equal to your height. Knowing this, it is just a matter of adding a few centimetres to your reach and you have a rough approximation of the distance between trees (Figure 3).

To check stocking, cut a piece of string 4 metres (13.1') long and tie one end to a tree branch in a representative section of the area you have cleaned. Take the other end of the string, pull it tight and move clockwise in a circle (Figure 3). Count the total number of uncut trees that are inside the imaginary circle and multiply that number by 200 (81 if using feet). This will give you an estimate of the total stems per hectare (per acre).

***** CAUTION *****

Since nothing in this world is exactly as described in books, you are going to have to use common sense in applying any treatment. For example, you might encounter pockets of bigger, older trees scattered throughout the area you are going to clean. Bypass these areas. It is not worth your while to clean trees

FIGURE 2

TREATMENT LAYOUT

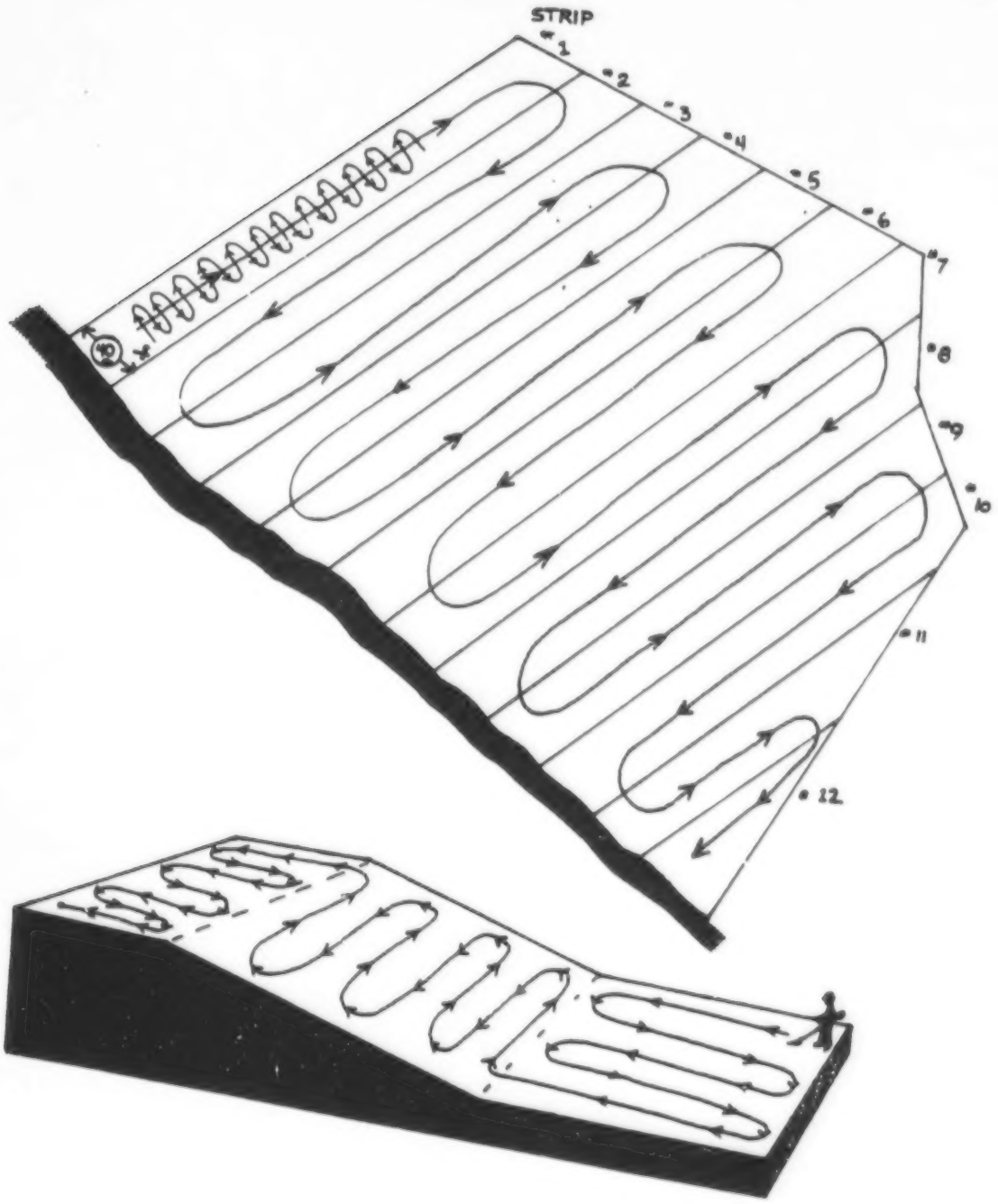
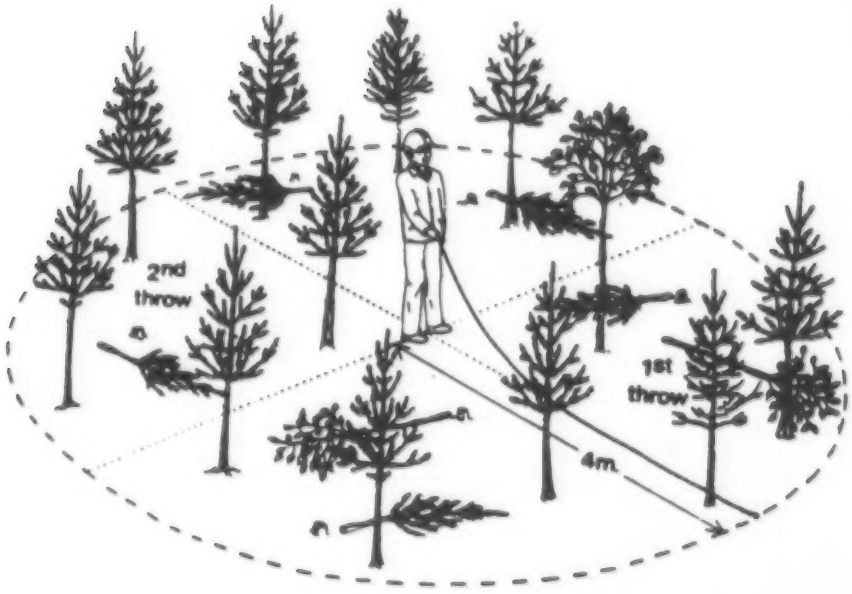


FIGURE 3

METHODS OF CHECKING SPACING AND STOCKING

SPACING

STOCKING



that are pulpwood size. Large hardwood trees with spreading crowns take up a lot of growing space. Usually in an area that is suitable for cleaning there are not enough of these trees to make it economical to remove them. Felling large trees will cause damage to the crop trees that you are trying to develop. Girdle these trees, don't cut them.

Whenever you find openings in the stand avoid enlarging them. You can remove selected trees from around the edge of the openings but keep the remaining trees closer together than you have in the denser parts of the stand.

Cleaning mixedwood stands with a high hardwood component does not always give the desired results. The cut hardwood often produces sucker growth that quickly overtops the softwood crop trees. When this occurs you will have to clean the area again.

CLEANING METHODS

There are two main cleaning systems that are used in Nova Scotia; mechanical and chemical. Mechanical methods are in turn subdivided into manual, motor manual and mechanized cleaning.

A) Manual Cleaning:

Manual cleaning involves cutting the trees with a poll axe or brush axe (Figure 4). Cleanings are rarely done today using these hand tools. They are slow, dangerous (particularly the axe) and are not suitable for larger diameter stems. Cleaning manually is very difficult to do for any length of time as it is physically demanding. In addition, manual cleaning leaves a sharp lance-like stump that is extremely dangerous to work around. The manual system of cleaning is rarely used in Nova Scotia.

B) Motor Manual Cleaning:

Motor manual cleaning involves the use of chain saws or clearing saws to space the trees (Figure 4). This is the most common approach to cleaning in the province. It is efficient, productive and assuming you use the proper equipment and technique, safe.

There is a certain amount of controversy about which is the better tool to use, the chain saw or the clearing saw. There are situations where it is better to use one over the other. For example, the chain saw

FIGURE 4

CLEANING TOOLS

A) MANUAL

B) MOTORIZED MANUAL

is much better suited to cleaning where there is a significant number of trees with diameters over 10 cm (4"). The clearing saw has a tendency to bind and it takes a long time to cut through the bigger trees. If the area being treated supports a number of larger trees, scattered residual trees and/or large wolf trees, a chain saw might be the best tool for the entire cleaning job. Another advantage to the chain saw is that many woodlot owners have one. It may not be the best tool for many cleanings, but it is the most useful all around tool for a woodlot.

The chain saw has a number of disadvantages.

1) it is tiring and difficult to cut the trees low to the ground,

2) there is a greater chance of hitting stones, the ground and other trees with the tip of the saw,

3) there is a higher risk of injury as a result of chain saw kickback (Figure 5),

4) the most important disadvantage of the chain saw is it is awkward to use and is therefore very tiring over extended periods of time. This makes it generally less productive than the clearing saw,

The clearing saw is the most effective tool for most of the cleanings you will do.

1) it is designed to cut low to the ground,

2) it is very fast if used properly in young trees that averages less than 10 cm (4") in diameter,

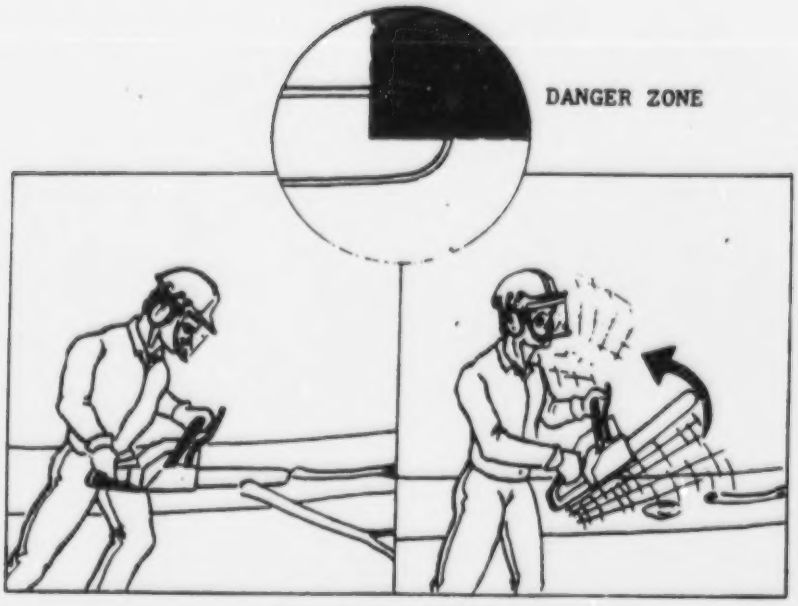
3) since you can stand erect while cutting, you are away from the smoke and much of the noise. Being erect allows you to easily see the next tree you are going to leave, thus enabling you to plan your work,

4) small whip-like trees are easier to cut with the clearing saw and there is less chance of injury,

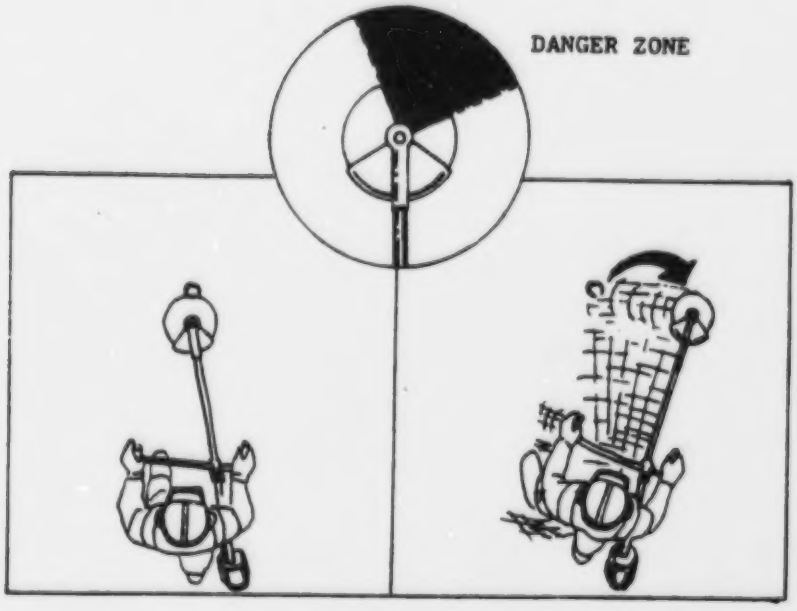
5) the clearing saw is less tiring to use over extended periods, resulting in higher productivity and better quality work,

FIGURE 5

KICKBACK



CHAIN SAW



CLEARING SAW

You will have to decide if the amount of cleaning you will be doing on your woodlot will justify the expense
of a speciality tool such as a clearing saw.

C) Mechanical Cleaning:

Mechanical cleaning involves the use of a machine to mow down strips of trees on a cleaning site. The machine is basically a tractor, wheeled or tracked, with some type of mower attached to the front or rear (Figure 6). Mechanical cleaning is thought to be labour saving and faster than motor manual systems. While there have been a number of experimental cleanings using the mechanical system, there have been a lot of problems. This system removes all trees in a strip, causes some damage to the border trees along each side of the strip and also the machines have difficulty operating effectively on areas that are not free of boulders and stumps. Mowing also leaves a high number of stumps that are not cut low enough. In some cases a branch growing below where the tree is cut grows into an unwanted competing tree. This system is, for the most part, suited for the larger tracts of forest.

D) Chemical Cleaning:

Herbicide spraying is another cleaning method used in Nova Scotia to clean young stands.Chemical sprays are used primarily to kill competing hardwood trees and shrubs. They are applied in two ways, from the ground and from the air. Ground application is done with back pack sprayers, motorized mist blowers or machine mounted sprayers. Aerial application can be done with a fixed wing aircraft or a helicopter.

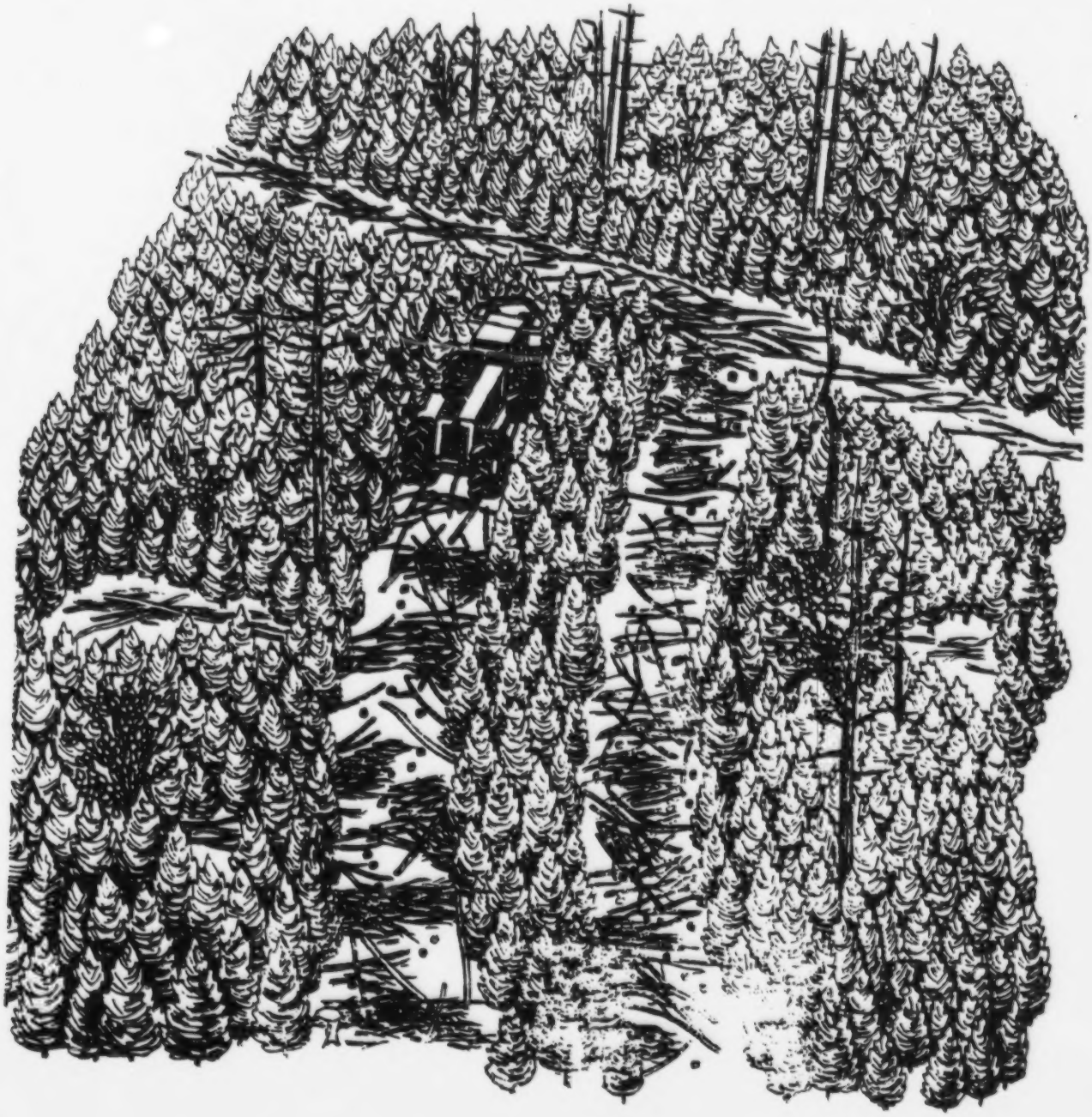
Choice of spraying equipment depends on many factors such as: availability of equipment, size of area to treat, cost, manpower available, government regulations and herbicide to be used.

Depending on the chemical used and the rate of application, herbicides are used to kill hardwood species such as maple, birch, aspen, pin cherry and alder. They are relatively inexpensive to apply and can cover large areas over short periods of time.

The use of chemical methods of cleaning has certain drawbacks. They present a potential danger to the environment if not used properly. Chemicals should not

FIGURE 6

MECHANICAL STRIP CLEANING



be used on stands adjacent to dwellings or waterways. No one should attempt to use chemical sprays without adequate training in their use and appropriate safety precautions.

Herbicides are limited in satisfying the various purposes of cleaning. In Nova Scotia they are presently used to kill hardwoods - spacing occurs only where there is hardwood killed. For example, a desired crop tree might be crowded by another softwood. Chemicals will not release this tree. In practice chemical cleaning is followed up by motor manual cleaning to release softwood crop trees. .

QUIZ

True or False

_____ 1. The average height for stands to be cleaned should be between 2m and 6m (6' to 20').

_____ 2. On site class 6 trees may be spaced to 1.8m x 2.4m.

_____ 3. A cleaning should be done on stands less than 60% stocked.

_____ 4. A cleaning will increase the merchantable yield of the stand.

_____ 5. Cleaning with an axe is a safe and efficient method.

_____ 6. A cleaning may improve the species composition.

_____ 7. A clearing saw is an ineffective tool for a cleaning.

_____ 8. A cleaning will improve crown and root development.

_____ 9. Where possible, a mixture of species should be left in the stand.

_____ 10. When an opening occurs in the stand leave it denser along the edges.

LESSON NO. 2

PREMERCHANTABLE THINNING

Definition

Premerchantable thinning is a spacing operation carried out in young stands that are just past the sapling stage of development but have not reached the size where the treatment produces merchantable wood (Figure 7).

STANDS SUITABLE FOR PREMERCHANTABLE THINNING

Stands that are suitable for a premerchantable thinning would have the following characteristics:

1) Have more than 4,000 trees/ha (1,600/ac) and are at least 60 % stocked.

2) Where at least 30% of the total trees are made up of suitable species that will benefit from spacing.

3) Average height is more than 6.0m (20') and average diameter is less than 14 cm (5.5").

4) Located on a site class 5 (5.0 m^3/ha/yr) or better.

5) Trees are well rooted to a depth of at least 30 cm (12").

6) Crop trees have healthy, well formed crowns, which represent at least 1/4 the total height of the tree.

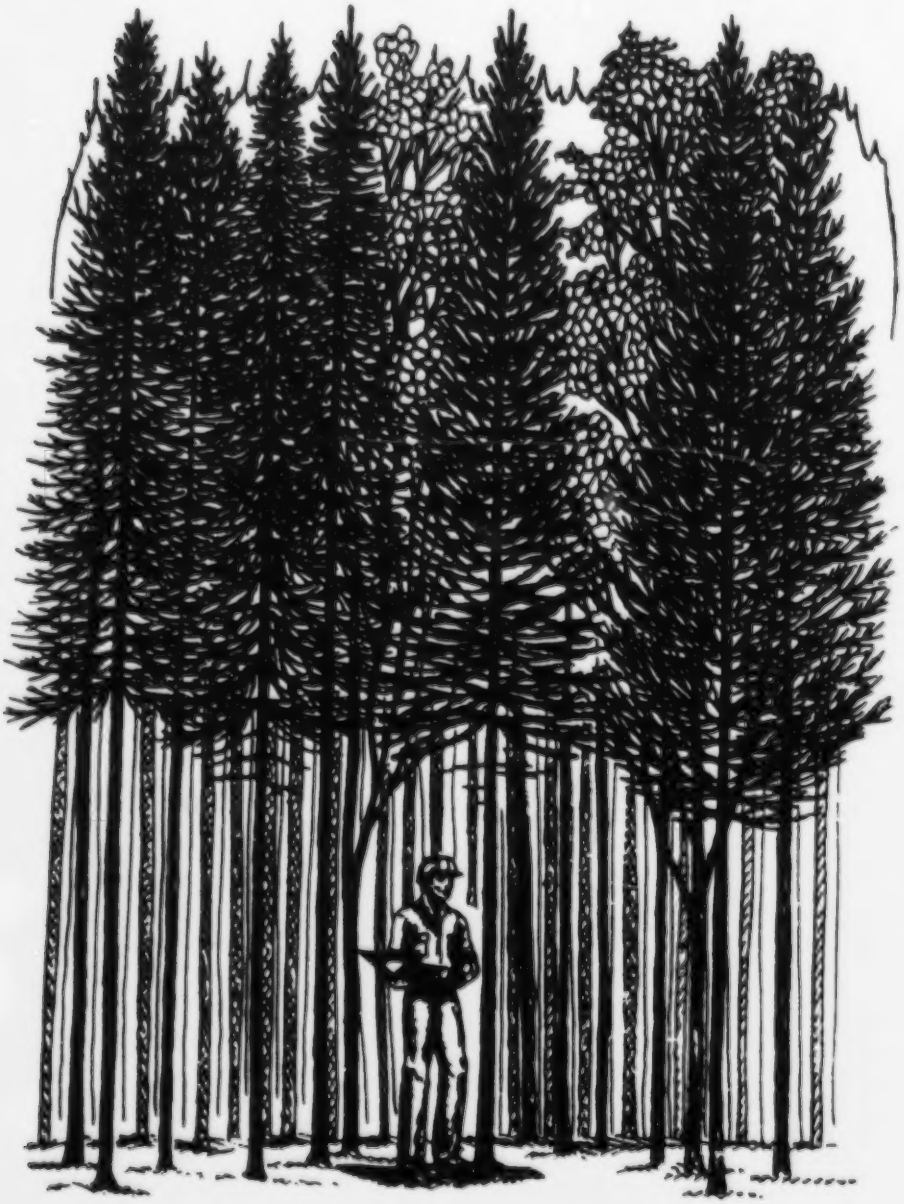
7) The crowns would usually be touching each other and interfering with tree growth.

8) Not located on sites exposed to excessive winds.

A premerchantable thinning is very similar to a cleaning. The major difference is that the trees are past the sapling stage when the spacing is done. In other words, a premerchantable thinning is much like a delayed cleaning. If you have done a cleaning in a

FIGURE 7

TYPICAL PREMERCHANTABLE THINNING



stand you normally would not do a premerchantable thinning. In fact, your next spacing treatment would be a merchantable thinning.

Like cleaning, premerchantable thinning involves the removal of undesirable trees to favour the growth and development of more desirable trees. Trees that should be cut are those that are damaged, malformed, of poor quality and that are crowding selected crop trees.

The type of tree that you want to select as crop trees should be the better quality, vigorous growing trees that are most likely to benefit from reduced competition. Favour species that are capable of producing the product you intend to harvest. Check with the local N.S. Department of Lands & Forests for information and advice.

When deciding which trees to cut and which trees to leave as crop trees, always keep in mind what products you are trying to develop for harvest. See the chapter on cleaning for more detail about which type of tree to cut and which to keep as crop trees.

EXPECTED GAINS FROM PREMERCHANTABLE THINNING

There are certain gains to be expected from doing a premerchantable thinning. These gains are:

1) To increase the merchantable yield from the stand.

2) To increase the rate of diameter growth and thus shorten the time between possible harvests.

3) Reduce the amount of merchantable small diameter trees at harvest.

4) Reduce harvest cost by producing larger diameter trees with less diameter variation.

5) Improve the species composition of the final crop.

6) Develop stronger root systems which permit future spacing treatments.

7) Allows for the development of a higher percent of sawlog quality trees than would

be produced in untreated stands.

It is important to understand that the younger the stand the more the trees will respond to spacing. Therefore, the gains from premerchantable thinning will be less than if the same stand was cleaned. The gains from a premerchantable thinning are, however, worth the effort of spacing and these gains are much more than if the stand was not spaced at all. It is important to note that while the volume of the treated versus the untreated stand will be the same at rotation age, by premerchantable thinning the average size and general quality of the trees will be substantially greater than if the stand was not treated.

There are some cases when premerchantable thinning is a better choice than a cleaning. In Nova Scotia there are basically two situations where you should wait and do a premerchantable thinning rather than a cleaning. They are in some hardwood and white pine stands. Cleaning in hardwood stands tends to produce limby trees. By leaving the stand denser until it is pole size you will encourage self-pruning and the development of sawlog quality trees. Generally speaking, delaying spacing a stand until it is pole size tends to reduce stem taper thereby producing a higher percentage of sawlog quality trees at harvest.

White pine stands are very susceptible to weevil attack in Nova Scotia. One method of minimizing damage from weevil attack is to leave the trees close together until they reach about 8 metres (26') tall. This will promote the development of a straight butt log. In these stands it is generally the codominant or lower crown class tree that escape weevil injury and damage. A premerchantable thinning at this time, removing the damaged dominant trees would release the better quality trees. Unless released at the pole stage many of these desirable trees will die out or stagnate, leaving a stand of damaged trees.

***** CAUTION *****

It is important to remember that the longer you leave the first spacing the less chance the crop trees have to develop stronger root systems and the greater the risk of blowdown after the treatment.

HOW TO DO A PREMERCHANTABLE THINNING

The steps to follow to successfully do a premerchantable thinning are the same as you would follow to

do a cleaning:

1) Identify a suitable stand

Follow the guidelines listed earlier in this chapter.

2) Determine what are desirable and undesirable trees

Medium to tolerant species that are of good quality, form and vigor should be favoured. For example, favour red spruce, white pine, black spruce, eastern hemlock, sugar maple, yellow birch, red oak and white ash over balsam fir, white spruce, larch, red maple and white birch. Similarly select healthy, straight, single stem trees over diseased, malformed (e.g. forked, double leader), damaged (e.g. porcupine chewed) trees.

3) Determine the correct spacing for the species and site

Remember that trees grow at different rates on different sites and therefore, respond differently to spacing. For spacing guidelines for different sites see the following list:

Site Class	Recommended Spacing	Trees left After Spacing
4 & 5	1.8m x 1.8m (6' x 6')	3,000/ha (1,200/ac)
6 & 7	to 2.1m x 2.1m (7' x 7' to 8' x 8')	2,300/ha (920 - 680)
8+	2.4m x 2.4 m to 3.0m x 3.0m (8' x 8' to 10' x 10')	1,700/ha 1,100/ha (680 - 440)

For example, in the case of site class 6 and 7 when there is a range of acceptable spacing, the wider spacings should be used in stands where the trees are at the top of the diameter range and/or for the tolerant hardwoods. Remember that while these uniform spacings are what you are trying to achieve, they are averages and will vary throughout the stand.

Constantly check your spacing using a measuring tape or premeasured stick. It is advisable to contact someone trained in forestry to establish the proper

spacing and desired species before you cut the first tree.

4) Organize the work

When spacing large areas try to organize the job into workable size blocks or strips. Use the method outlined in chapter 9. Since the trees are taller in a pole size stand and it is difficult if not impossible to see any distance, it is to your advantage to learn how to use a compass to lay out strips.

5) Exercise caution

Try not to enlarge any existing openings. Space trees a little closer around the edges of these openings. Avoid damaging selected crop trees by cutting into them or knocking cut trees against them. Whenever you damage a crop tree you reduce that trees ability to respond to the spacing.

PREMERCHANTABLE THINNING METHODS

The various premerchantable thinning systems are the same as for cleaning; manual, motor manual, mechanized and chemical.

A) Manual premerchantable thinning

Manual spacing of pole size stands is an inefficient, tiring job that is generally limited to small occasional jobs done by the woodlot owner. It is very difficult to swing an axe or brush axe in a dense pole size stand. If the density did allow you to manually space, it is very tiring and there is a high risk of injury. This method is not recommended for most jobs.

B) Motor Manual Premerchantable Thinning

Motor manual premerchantable thinning is the most common system that is used. Providing you use the proper equipment and technique, it is productive, safe and relatively inexpensive. It allows good control of species selection, spacing and minimizes damage to crop trees. Unlike cleanings where the clearing saw is the most effective tool to use, the chain saw is the most appropriate tool. Many of the trees that will be cut in a premerchantable thinning are too large in diameter for the clearing saw.

C) Mechanized Premerchantable Thinning

Mechanized premerchantable thinning is limited to large areas and is not widely used in Nova Scotia on an operational basis. The same disadvantages apply in a premerchantable thinning as apply in a cleaning.

D) Chemical Premerchantable Thinning

The disadvantages of using chemicals on small woodlots is basically the same as their use in cleanings. Generally, broadcast application of herbicides, either from the air or from the ground are intended to kill hardwoods and leave the softwoods unaffected. By varying the timing of the application with respect to the growing season, it is possible to kill the softwoods as well. Herbicides are less selective in that once you have identified your target trees and areas, all trees within the spray path are killed, whereas, in chain saw thinnings, one can select individual crop trees within the work strip to be removed. The broadcast application of herbicides for premerchantable thinning is less flexible terms of determining the final spacing of crop trees.

A popular method of chemically killing selected trees by hand in a premerchantable thinning is to use a hypo-hatchet. When the tree is hit with the hatchet a predetermined amount of chemical is injected into the wood. Often you will have to hit the tree in three or four places in a ring around the trunk to ensure a good kill (Figure 8). This method is best used along with a chain saw. Use the chain saw for the smaller trees and use the hypo-hatchet on the larger residual trees that may damage crop trees if felled.

As far as a tree is concerned, it will be released from competition if the trees crowding it are killed. There is no biological reason to cut the crowding trees down. However, if you cut a tree and leave it lying against the crown of a crop tree, it will interfere with the crop trees ability to take full advantage of the release. In addition, trees that are killed but not felled may cause damage to crop trees by whipping them during storms. Whenever possible cut the undesirable trees and push them to the ground.

However, when dealing with large residual trees, potential damage to crop trees by felling, generally out weighs the benefits of physically removing them from the stand. An effective way to kill these trees (and thus to release the crop trees) is to girdle them

FIGURE 8

HYPO - HATCHET

with your chain saw. Make sure that you cut the cambium all the way around the trunk. You will be surprised how little cambium it takes to keep the tree alive.

QUIZ

True or False

_____ 1. A premerchantable thinning is a spacing carried out in young stands that are just past the sapling stage of development, but have not reached the size where the treatment produces merchantable wood.

_____ 2. A spacing is delayed in hardwood stands until it reaches sapling stage to promote self-pruning for sawlog quality stems.

_____ 3. A premerchantable thinning will not increase diameter growth.

_____ 4. Premerchantable thinnings are carried out on site classes of 4 or higher.

_____ 5. Trees left as crop trees should be good quality, vigorous growing stems.

_____ 6. Balsam fir and red maple should be favoured over red spruce and sugar maple.

_____ 7. Trees on a site class 5 should be spaced to 3.0m x 3.0m.

_____ 8. The chain saw is the most appropriate tool for motorized manual premerchantable thinning.

_____ 9. Felled trees should not be in contact with trees left to form the stand.

_____ 10. The younger the stand the more it will respond to a spacing.

LESSON NO. 3

MERCHANTABLE THINNING

Definition:

As a stand approaches maturity and has trees that are marketable size, the operation of spacing is called merchantable thinning (Figure 9). Its aim is to increase productivity by harvesting trees that would normally be lost to mortality and to promote the size and quality of the crop trees.

STANDS SUITABLE FOR MERCHANTABLE THINNING

Stands that are suitable for and would benefit from merchantable thinning would have the following characteristics:

1) located on a site class 4 (4 m^3/ha/yr) (0.7 cd/ac/yr) or better,

2) have an average merchantable stand diameter of 14 cm (6") or greater,

3) have 60% stocking or better,

4) where at least 40% of the total trees are comprised of desirable species that will respond to a spacing,

5) have crop trees with at least 1/3 of their total height as healthy, live crowns,

6) are windfirm and are located on exposed sites,

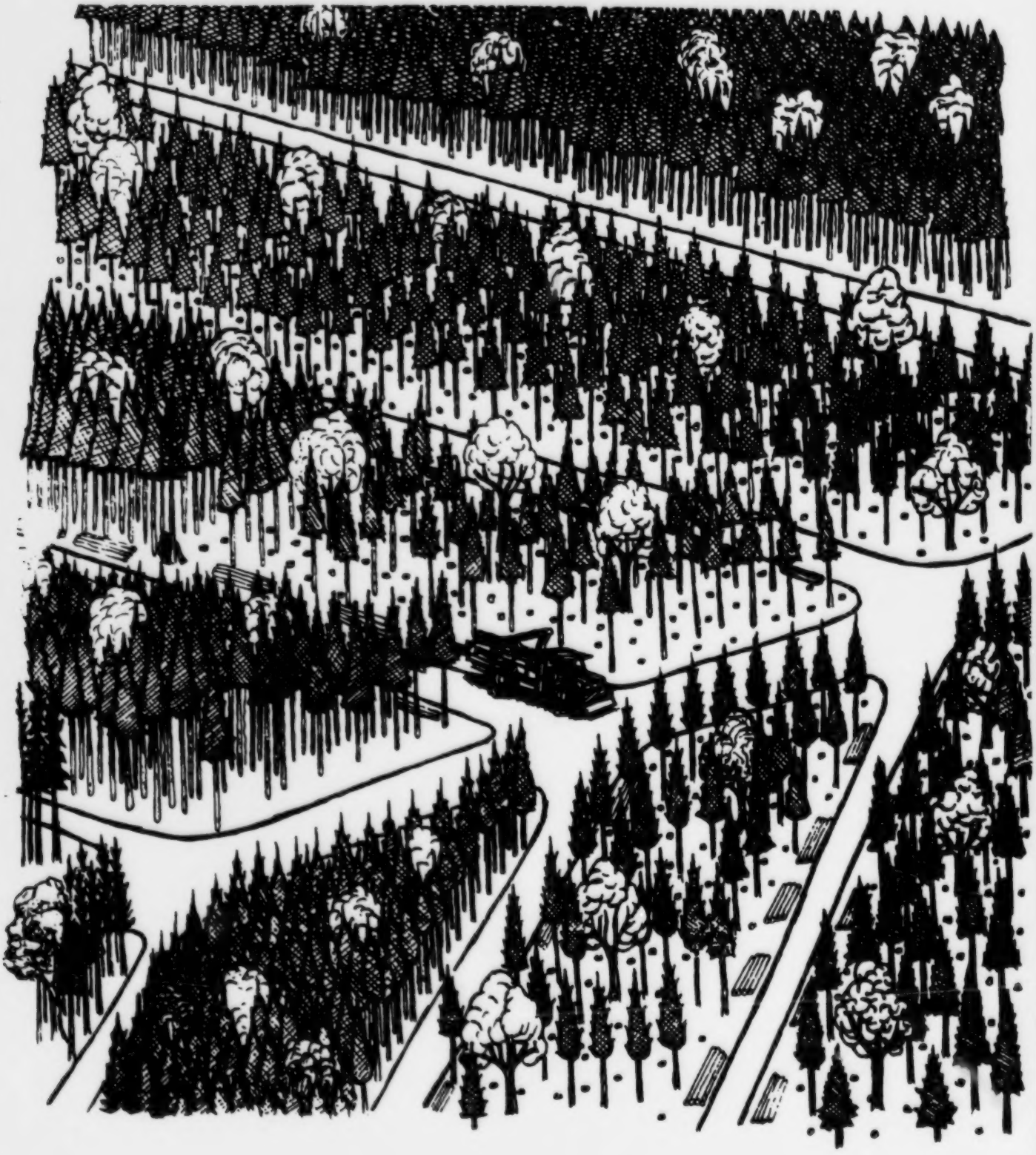
7) show a decrease in rate of diameter growth over the last few years (annual rings are closer together near the bark), caused by competition,

8) healthy, vigorous and are expected to remain so for at lest the next 20 years,

9) preferably have been spaced before - cleaned or premerchantably thinned,

FIGURE 9

TYPICAL MERCHANTABLE THINNING



***** CAUTION *****

Provided all the above listed factors are met, for black spruce stands thin only if less than 50 years old. For balsam fir and/or white spruce thin only if less than 40 years old.

Species Selection

Before beginning the thinning, future crop trees should be selected and marked. These are the trees that are intended for the final harvest. Crop trees should be the healthiest, most vigorous trees of the best quality and of the most desirable species. These trees are usually dominant or codominant trees. Always select trees that will respond to a release and increase their diameter growth. The following list indicates the major species found in Nova Scotia that respond well to thinning.

a) Red Spruce
b) Red Pine
c) White Pine
d) Eastern Hemlock
e) Sugar Maple
f) Yellow Birch
g) Red Oak
h) White Ash

(N.B. not ranked in any order)

In most cases select spruce and pine over fir and tolerant hardwoods (except beech) over intolerant hardwoods. A rule of thumb is to, whenever possible, identify about 1,400 (570/ac) potential crop trees per hectare in softwood and mixedwood stands and about 900 (360/ac) potential crop trees per hectare in hardwood stands.

Basal Area in Merchantable Thinning

In order to ensure that the stand is capable of replacing through growth the wood removed through thinning, the amount of wood (number of trees) must be closely regulated. As previously mentioned in Module 1 - chapter 4, basal area is an expression of stand density. Since basal area unlike volume can be measured directly from standing trees, it is the measure most commonly used to determine the amount of removal required. It is the most common measure used by trained forestry personnel to regulate volume removal by thinning. Several checks should be done during the course of the thinning so as to ensure proper spacing of the residual stand.

Trees to be Removed

Those trees that are to be removed should be of the poorest quality, the least desirable, shorter lived, intolerant species and the lowest value trees (e.g. defected, malformed trees). Any trees which are likely to die or fall down over the next 20 years or so should be removed. A tree blowing down after the spacing will create too large a gap between crop trees and may cause physical damage. It is common in Nova Scotia to thin from below, that is removing mostly intermediate and suppressed trees. You only remove dominant and codominant trees when they are of very poor quality, damaged, diseased and not likely to survive to harvest. In addition, you would remove these trees if they were crowding neighbouring better quality crop trees.

***** CAUTION *****

In any operation that involves selectively removing parts of a stand, particularly merchantable thinning, you must take extreme care not to create conditions that will make the stand unduly susceptible to blowdown.

For most merchantable thinning treatments on average sites in Nova Scotia you should not remove more than 40% of the stand basal area. On the very best sites and for certain species such as white and red pine, you can safely remove 50% to 60% of the stand basal area.

If a stand has been spaced before by cleaning or premerchantable thinning, it will be more windfirm than the same stand not previously spaced.

Avoid creating large holes in the stand that will not be used by the crop trees. These holes tend to produce a stand composed of limby, open grown type trees that are susceptible to blowdown and they reduce the yield of good merchantable wood at harvest time. If necessary leave a few undesirable trees to ensure adequate, uniform spacing throughout the stand.

Whenever you do encounter openings in the stand try not to enlarge them. If possible don't cut trees around the edge of these holes. In cases where the edge trees must be spaced, use a closer spacing than you have for the rest of the stand.

Leave approximately 15m (50') adjacent to a clear-

cut and/or field unthinned to minimize the risk of blowdown.

It is best to do merchantable thinning operations when the soil is dry and/or frozen to minimize potential damage to the root systems and the site.

Thinned jack pine stands are very susceptible to blowdown.

EXPECTED GAINS FROM MERCHANTABLE THINNING

The basis of all spacing treatments is to remove enough trees to release the selected crop trees. Enough trees should be left so that over a reasonable time period the remaining trees will respond to use the available growing space and approach a fully stocked stand. In doing so the stand will replace through growth, a volume equivalent to or greater than the volume removed by spacing. Any spacing that does not accomplish this will decrease the overall volume of the stand. While in reality most stands will never reach full stocking because of the openings which are normally found in stands, the objective is to strive for it.

If you plan your merchantable thinning with the idea that you eventually want a fully stocked stand you will realize the benefits listed below.

1) salvage of merchantable wood that would normally be lost due to competition before it is harvested; this allows you to generate income from the stand during the rotation,

2) enhance the value of the crop trees by increasing the rate of diameter growth and therefore the size of trees at rotation,

3) improve the general quality and therefore the value of the crop trees,

4) improve the species composition to prepare for the establishment of the next crop,

5) reduce harvest costs by concentrating the volume on fewer trees and developing less variation in diameters of the crop trees at harvest time,

6) Develop a more windfirm stand thereby allow-

ing you more choices in the type of harvesting system you can use,

The intensity (amount of wood removed) of a merchantable thinning is based on opening the stand only enough to allow the crop trees to benefit. Keep the space between the crop trees close enough so that the total available growing space will be used by the crop trees within 20 to 30 years. In other words, open the stand up with the idea that within 20 to 30 years it will approach full stocking (Figure 10).

As previously mentioned in the chapters on cleaning and premerchantable thinning, if you have healthy, vigorous trees of the right species then the better the site the greater the response to spacing. Therefore, the amount of wood that can be removed in a merchantable thinning and still allow the stand to approach full stocking within 20 to 30 years, varies with the quality and capability of the site. For examples of the maximum basal area (listed as a percent of the total stand basal area) to remove in previously untreated softwood and mixedwood stands see the following chart.

A) Site: moderately exposed to winds, well drained, deep soils (>30cm) (12")

Species	Capability Classification 4	5	6	7	8+
Red, Black, White Spruce Balsam Fir, Jack Pine and Eastern Hemlock	N.R.*		30%		
Red and White Pine	30%		40%		

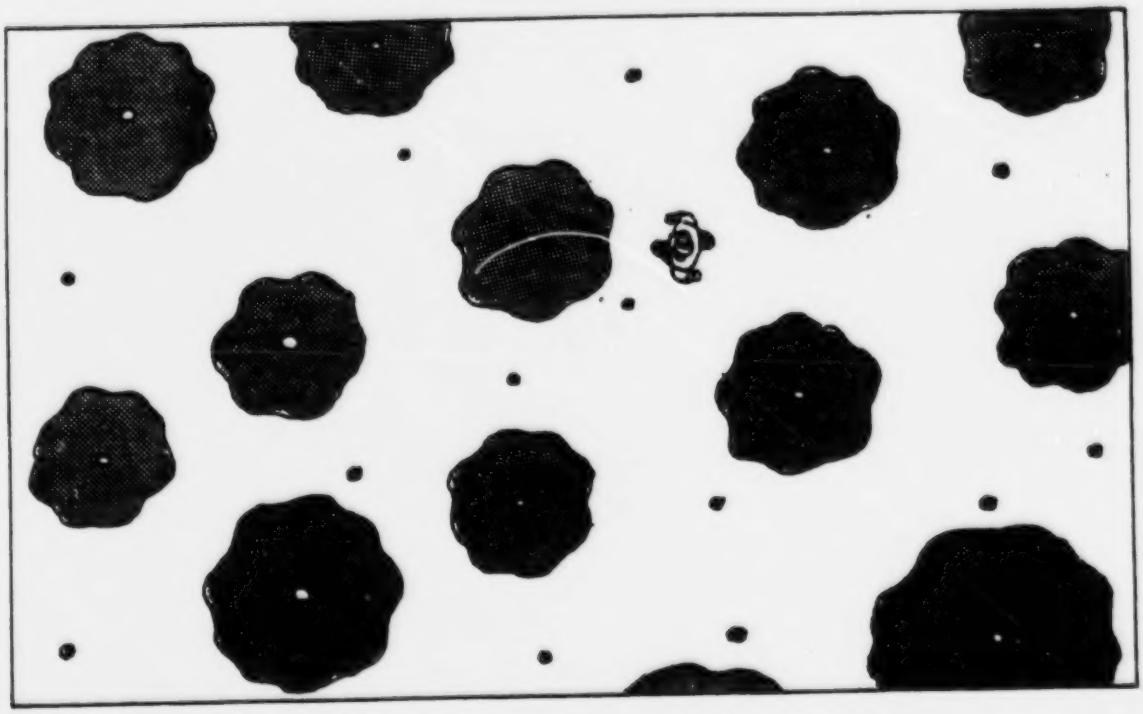
* Note: N.R. = not recommended

B) Site:sheltered,well drained, deep soils ((>30cm)(2"))

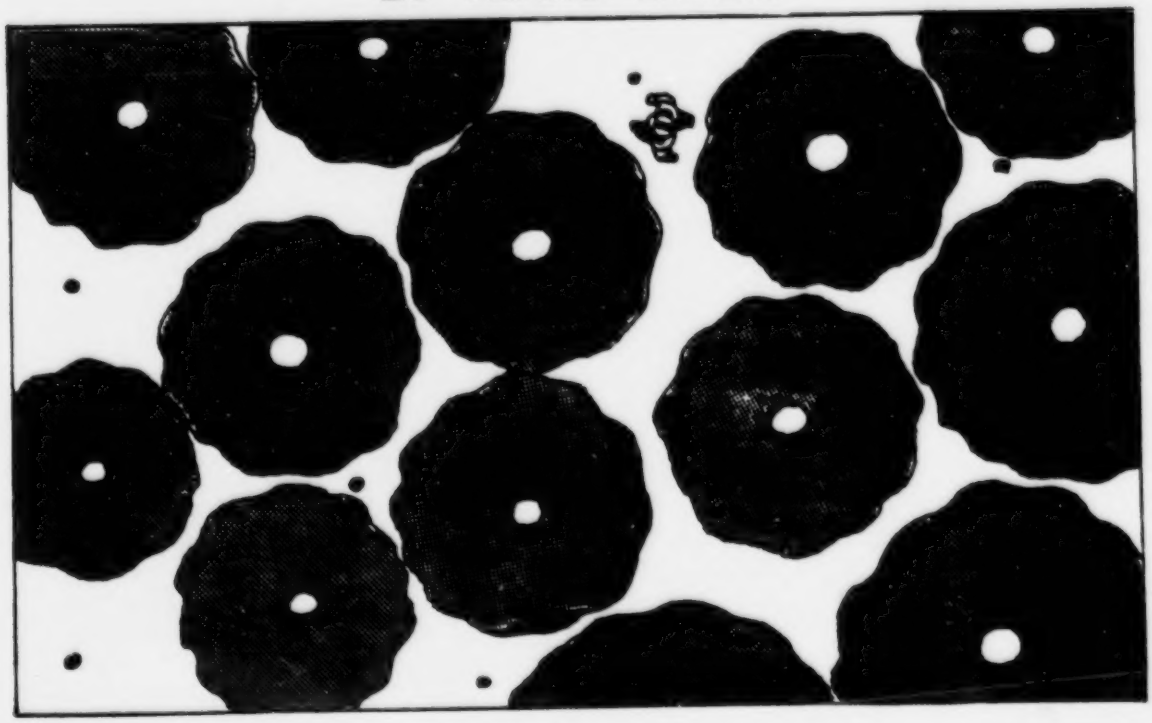
Species	Capability Classification 4	5	6	7	8+
Red, Black, White Spruce Balsam Fir, Jack Pine and Eastern Hemlock	N.R.*		40%		
Red and White Pine	40%		50%		

FIGURE 10

CROWN CLOSURE AFTER THINNING
(AERIAL VIEW)
YEAR 1



20 YEARS LATER



If the stand has been previously treated, more volume can be removed and spacing can be wider than in previously untreated stands. A guideline indicating the maximum percent of removal for softwood and mixedwood stands previously treated is listed below.

A) Site: exposed to winds or imperfectly drained or shallow soil

Species	Capability Classification 4	5	6	7	8+
All species	N.R.*	30%			

* Note: N.R. = not recommended

B) Site: moderately exposed to winds, well drained, deep soil ((>30cm) (12"))

Species	Capability Classification 4	5	6	7	8+
All species	30%	40%	50%		

C) Site: sheltered, well drained, deep soil ((>30cm) (12"))

Species	Capability Classification 4	5	6	7	8+
All species	40%	50%	50%		

All this may seem very complicated to you. Don't hesitate to contact someone trained in forestry in your area to get advice. It is important to remember that the intensity of thinning depends on site capability, species, exposure to winds and whether or not the stand has been previously treated. A good rule of thumb is to remove approximately 30% to 40% of the total stand basal area. Remember you may not help the stand if you remove too little, but you will hurt it if you remove too much.

HOW TO DO A MERCHANTABLE THINNING

The importance of planning your work can not be over emphasized. Regardless of the type or nature of the silvicultural treatment you wish to apply to a stand, you will save time and money as well as achieve

better results if you carefully think through the operation before you cut the first tree. To properly approach a merchantable thinning follow these steps:

1) Identify a suitable stand

Follow the guidelines listed earlier in this chapter.

2) Determine the products you will be cutting and locate markets for them.

Before you cut try to estimate the type and quantity of the various products your spacing will generate. Remember one of the gains from a merchantable thinning is generating revenue before final harvest. No one wants to go to the expense and trouble of a spacing operation only to find out they can't sell the wood.

3) Determine what are desirable and undesirable trees.

Follow the guidelines listed earlier in this chapter.

Premarking of the stand will help you efficiently organize the work and will assist you in selecting which trees to cut and/or leave. It is much easier before the thinning to wander through the stand with a can of paint deciding which trees to cut or leave than it is to make that decision as you are cutting.

4) Determine the correct spacing.

Determining the correct spacing is a very complicated procedure. It involves knowing the basal area of the stand and determining the percent of the total stand basal area that should be removed. This information is then applied to a table to determine the number of trees that should be cut. This type of calculation should be done by qualified forestry people.

However, a good rule of thumb is to leave approximately 2.7 metres (9') between crop trees in softwood and mixedwood stands and 3.3 metres (11') between trees in hardwood stands.

Try to achieve uniform spacing throughout the stand.

5) Identify Extraction Methods

Before you begin the merchantable thinning make sure you know what type of machinery will be used to remove the wood to roadside. The choice of equipment should take into account factors such as the type of product, tree size extraction method, slope, ground conditions, and machinery available. The type of extraction equipment used will determine the location, size and characteristics of the extraction trails.

6) Locate and Establish the Extraction Trails

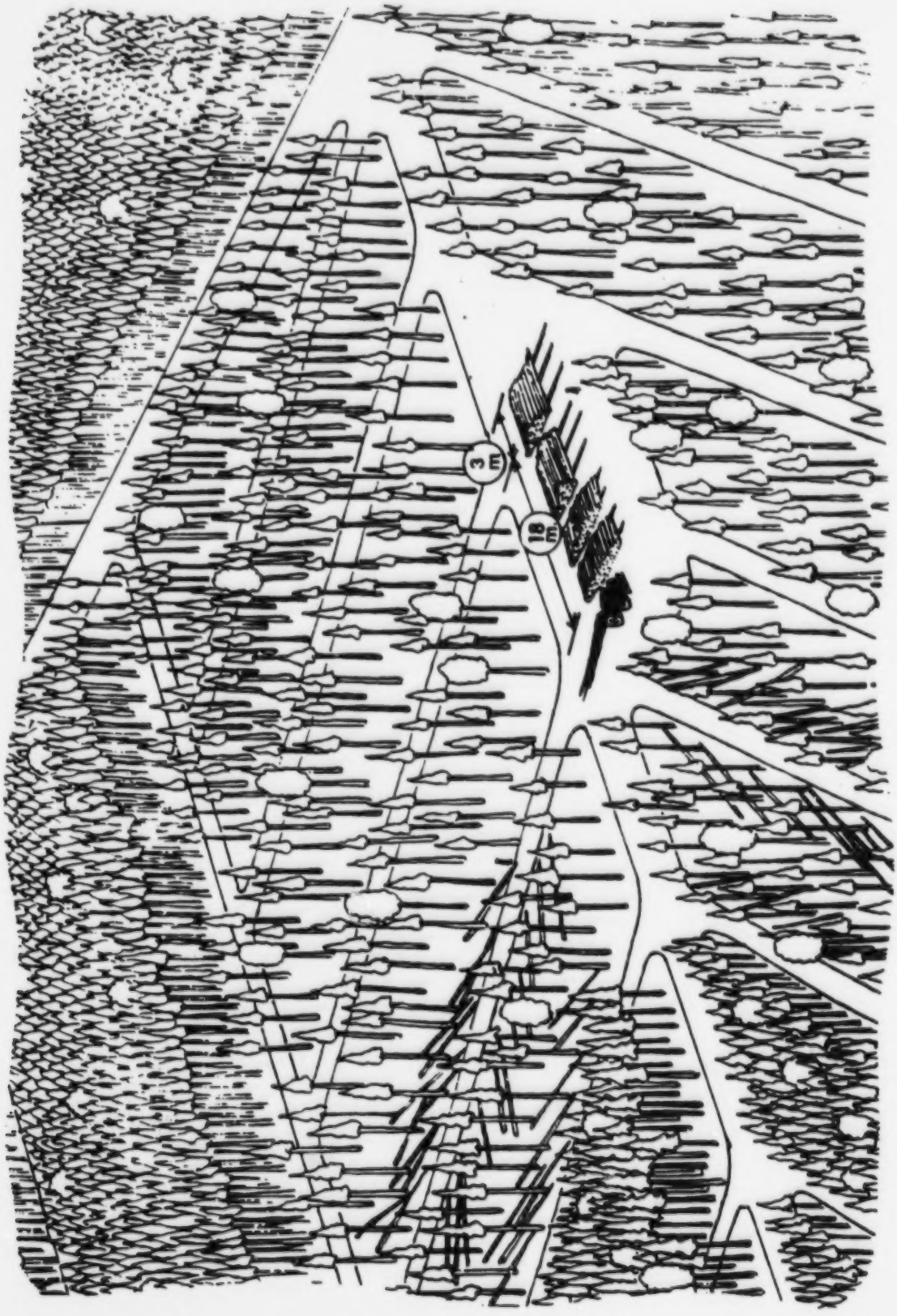
Lay out the trails, mark them with flagging tape and cut them first. The trails must be wide enough so that the extraction machinery can easily maneuver without damaging crop trees along the sides of the trails. This is about 2.5m to 3.5m (8' to 12') for most equipment. Keep the trails as straight and long as possible particularly in larger stands. On uneven ground and around curves widen the trails a bit. This will minimize damage to crop trees from the machinery leaning to one side on rough ground and as it makes turns. Trail location is primarily dependent on the extraction method. The shortwood system generally requires the wood to be moved by hand to trail side and therefore the trails should be kept close together (12m - 13m) (40' to 42'). Tree length and full tree methods use machines to move the wood to trail side and therefore the trails can be spread wider (24m to 36m) (79' to 118'). If conditions permit and the stand is large enough cut connector roads at the rear of the trails to allow driving between trails. (Figure 11) You will save time and money by not having to either turn around or backup machinery. Lay out the trails in a herring bone pattern pointing towards the main haul road. Keep stumps extra low on the trails to avoid damaging the equipment.

Keep in mind that depending on the frequency and size of the extraction trails, you are removing approximately 10% of the stand basal area, by cutting the extraction trails.

MERCHANTABLE THINNING SYSTEMS

There are two broad categories of merchantable thinning systems that are worth discussing from a practical view point. The difference between these two systems is based on what position in the canopy the trees to be removed are taken from.

FIGURE 11



Low Thinning:

Low thinning or thinning from below as it is known in Nova Scotia is one of the oldest thinning methods. In low thinnings, trees are removed from the lower crown classes and the majority of the crop trees are dominant and codominant trees (Figure 12). This type of thinning is most suitable to the natural evolution of a stand where the lower crown class trees normally die out. By doing this type of thinning you are making use of wood that would either stagnate and reduce the growth of better trees or would be lost to mortality.

Thinning from below is the safest method of thinning where blowdown might be a problem. By removing the majority of the trees from the lower height classes, openings in the canopy are not large and blowdown is minimized. This is a appropriate method when thinning species that are naturally susceptible to blowdown such as spruce and fir.

Crown Thinning:

In a crown thinning trees are removed from the middle and upper range of the crown and diameter classes rather than from the lower end (Figure 13). The larger trees in the stand are those selected for cutting. While the intent of this spacing treatment is to favour the development of the most promising trees of the dominant and codominant class - the same as thinning from below - you do so by opening up the canopy. In this thinning both your desirable and undesirable trees are usually dominant and codominant trees.

Crown thinning is basically different from thinning from below in two ways. The majority of the cutting is done in the upper crown classes and the bulk of the intermediate class remains after each thinning.

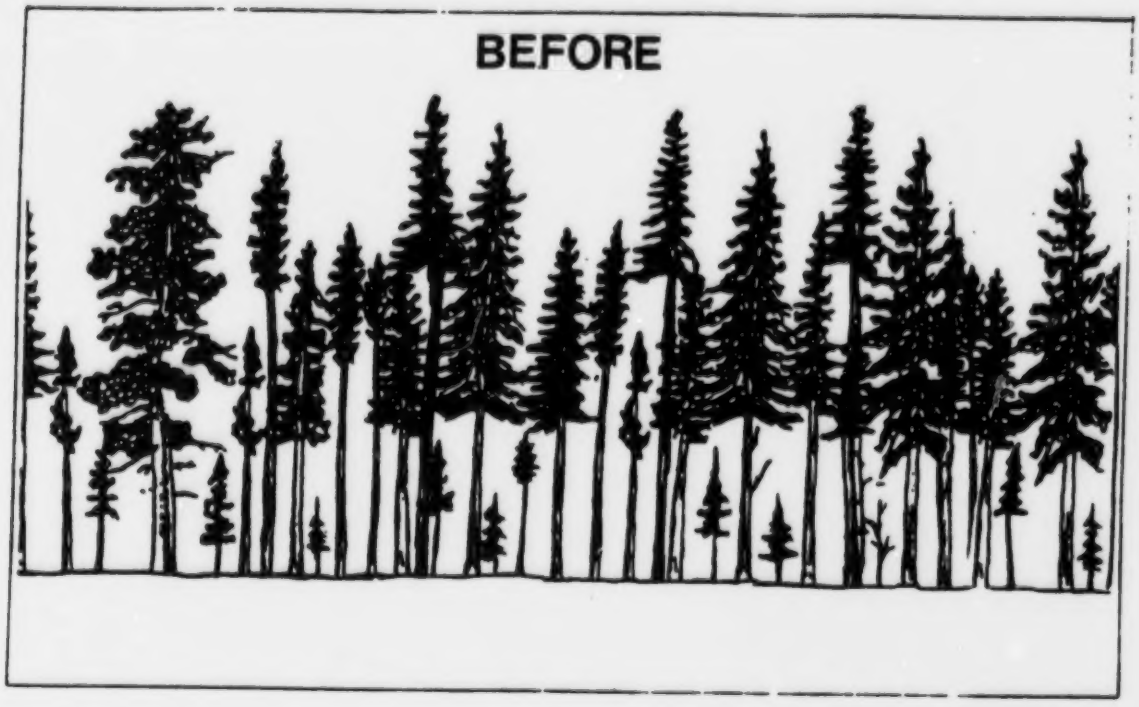
Crown thinning is usually applied in Nova Scotia only in windfirm stands such as sheltered red and white pine stands on deep soils.

Crown thinnings generate more wood and therefore more money than do thinnings from below. You are cutting larger wood.

In practice many thinnings carried out in Nova Scotia are a combination of low and crown thinning with the emphasis on low thinning.

FIGURE 12

LOW THINNING



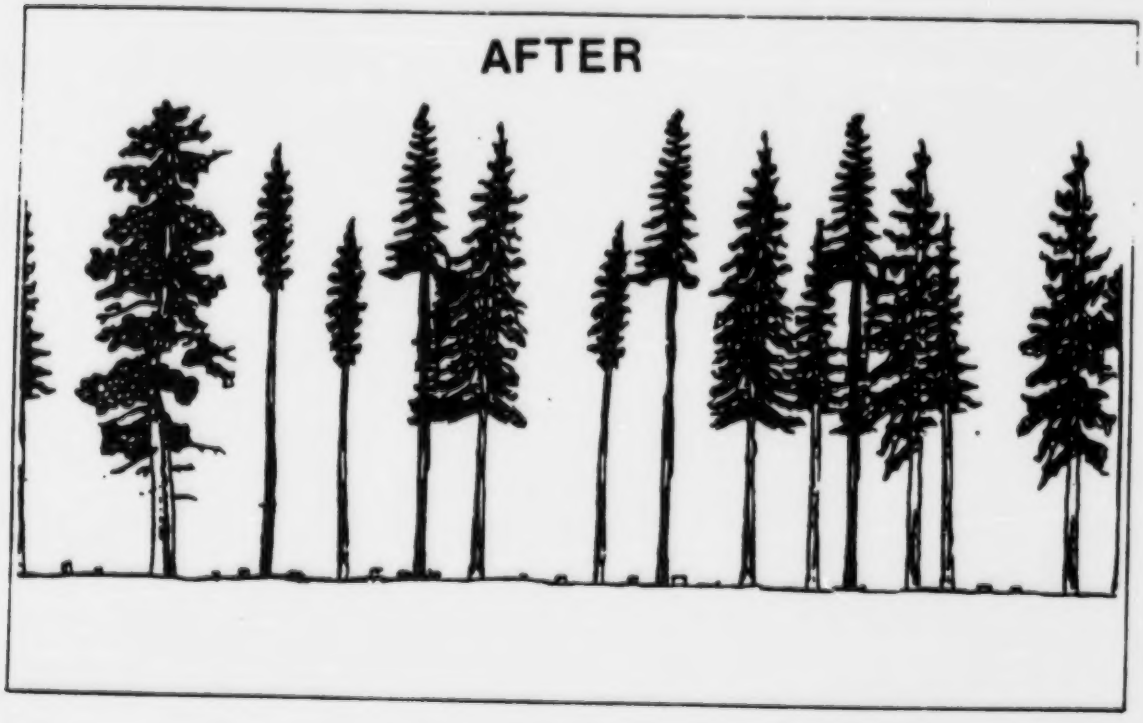
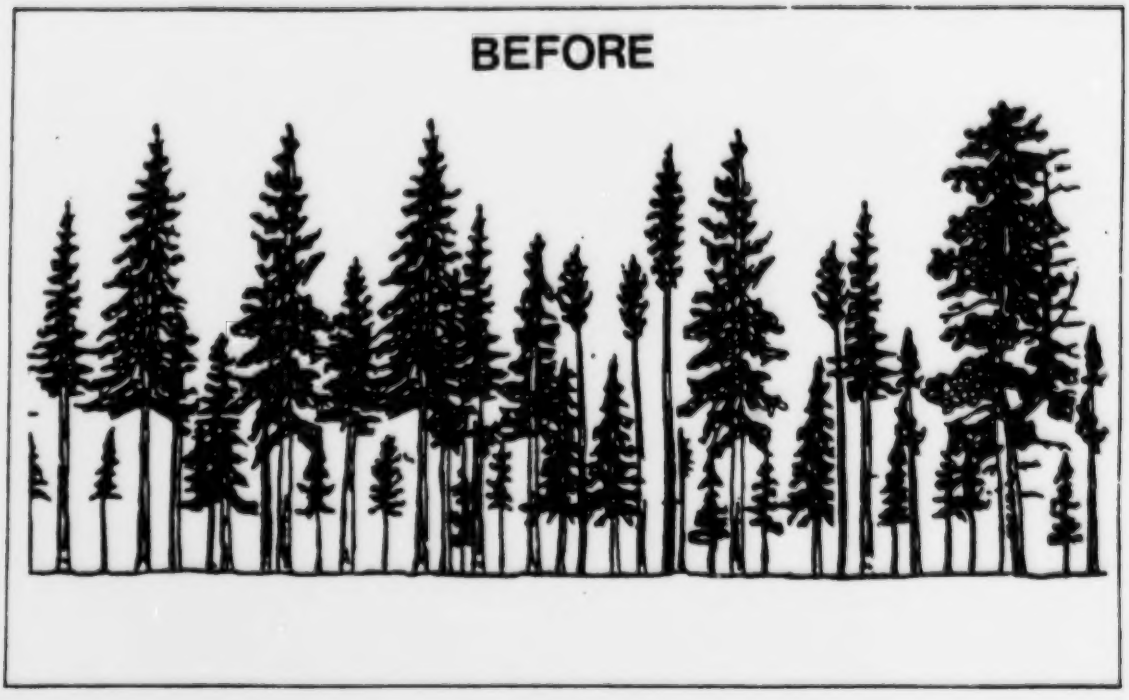
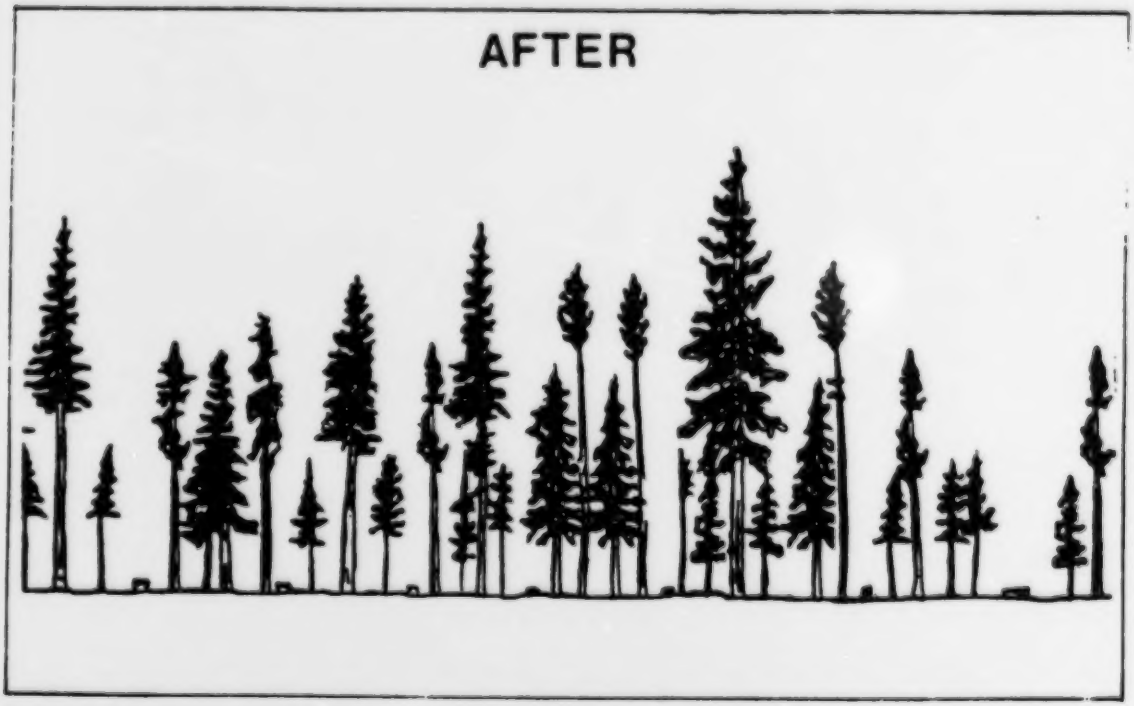


FIGURE 13

CROWN THINNING





It is important to remember that the silvicultural manipulation of a stand often begins with the harvest cut. The type of cutting system you chose for harvesting a stand, will to a great extent, determine the stocking and composition of the future forest. Therefore whichever harvesting method is used, the regeneration of the new stand must be considered.

EXTRACTION MACHINERY

There is a wide variety of extraction machines used in Nova Scotia. Some are more suitable for merchantable thinnings and other selection type operations and others are more suitable for large clearcut areas. Certain machines lend themselves to small woodlot jobs while others do not. While contractors need heavy duty production machines that are very expensive, small woodlot owners can adequately operate on their woodlots with less expensive and less powerful equipment.

Listed below are some of the more common types of machines found in the woods of Nova Scotia. The suggested extraction trail widths are also included. Of course, when the machine is being used on one of the clearcut operations trail width does not apply.

Type of Machine	Trail Width	Most Common Usage
Horse	2m (6.5')	small woodlot thinnings shelterwood & selection cutting
Farm tractor/ power wagon	2.4m - 3m (8'-10')	small woodlots, not for large scale operations
Farm tractor/ winch	2.4m - 3m (8'-10')	Small woodlots, not for large scale operations
Forwarder/ 2 cds or less	2.4m - 3m (8'-10')	good for any size operation
Forwarder/ >2 cds	3m - 3.6m (10'-12')	mostly used in large industrial clearcuts/ strip clearcuts

Skidder	3m - 3.6m (10'-12')	good for any size job

The following list indicates some of the types of machinery which are suitable for shortwood, tree length or full tree extraction systems. Examples of these methods are illustrated in figure 14.

Shortwood System	Tree Length System	Full Tree System
Skidder	Horse	Skidder
Forwarder	Skidder	Forwarder
Farm Tractor/power wagon	Farm Tractor/winch	

The shortwood system is the most common system used by woodlot owners in Nova Scotia today. It is generally easier and in terms of equipment, cheaper for a small woodlot owner who may already own a tractor and wagon. Also equipment such as winches or hydraulic loaders enhance the efficiency of this system.

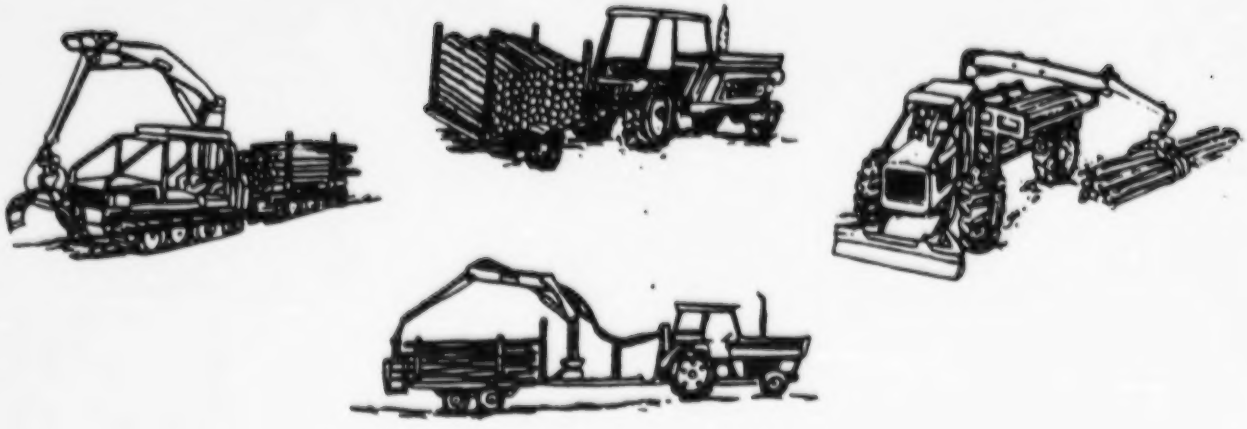
Increased silvicultural activity on small woodlots has caused an increase in the number of silvicultural contractors who work on these woodlots. These people need heavier industrial equipment that will endure continuous use. This has given rise to the introduction of a variety of shortwood extraction equipment such as the C-4 Dion and small forwarders that generally cannot be afforded by small woodlot owners working their own lots.

The tree length system has two distinct advantages over the shortwood system, it is more efficient from a cost view point and it allows for better utilization of the entire tree. Since the tree is bucked into various products at a landing, many small chunks of wood that may have been left in the woods in a shortwood system can be used.

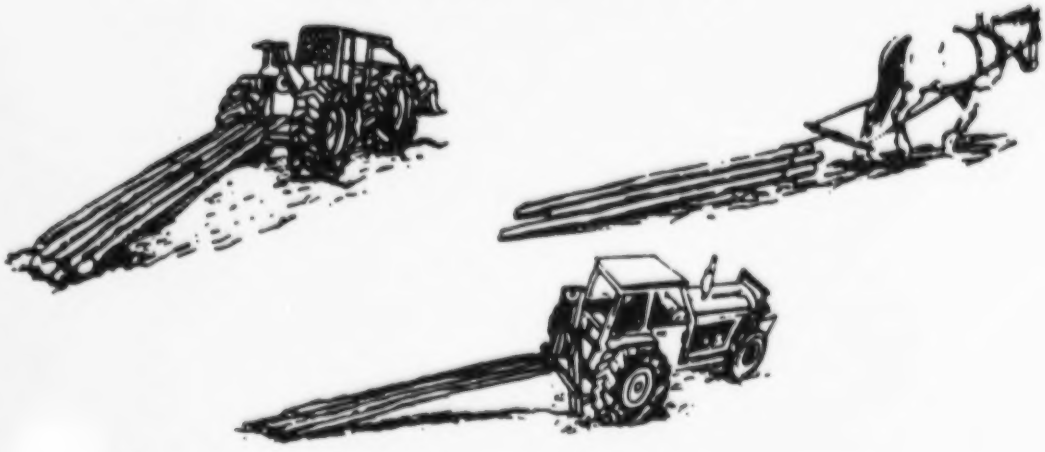
FIGURE 14

EXTRACTION METHODS

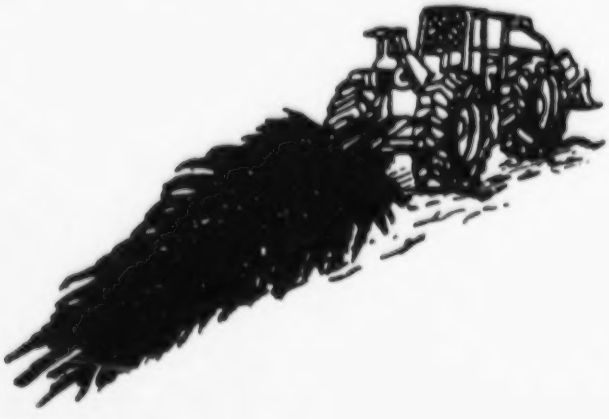
A) SHORTWOOD



B) TREE LENGTH



C)FULL TREE



QUIZ

True or False

_____ 1. A merchantable thinning will utilize merchantable wood that normally would be lost due to competition before it is harvested.

_____ 2. Premarking trees to be left will improve cutting efficiency.

_____ 3. A merchantable thinning is carried out in a stand which shows a decrease in rate of diameter growth over the last few years.

_____ 4. Blowdown damage in thinned stands is not a problem in Nova Scotia.

_____ 5. A merchantable thinning can improve species composition to prepare for the establishment of the next crop.

_____ 6. Extraction trails need not be straight or any wider than the machine used.

_____ 7. Approximately 70% of the basal area should be removed in a merchantable thinning.

_____ 8. A farm tractor and winch is a good extraction machine on small woodlots.

_____ 9. Balsam fir should be favoured over red spruce in a merchantable thinning.

_____ 10. A merchantable thinning will release selected crop trees so that they can utilize the available growing space.

LESSON NO: 4

WOODLOT MANAGEMENT EXERCISE

This lesson is designed to give you an opportunity to apply information you learned in the "Stand Spacing Module" to example stands. This lesson is set up in the same manner as the woodlot management exercise in module 2. Carefully read the stand information presented and decide on the treatment you would recommend if it was your woodlot. Use the information you have learned in the previous lessons and your good common sense to arrive at the treatment recommendation. After you have decide what you would do, compare your answer with the recommended treatments at the end of the lesson. Don't be disappointed if your choices are different. The most important aspect of the exercise is to teach you to apply your knowledge and experience to the management of your woodlot. GOOD LUCK!

STAND #1

Species	Percentage Composition	Age (yr.)	Height (m)	Diameter (cm)
Balsam Fir	80	40	12(39')	16(6")
Red Spruce	20	40	12(30')	16(6")

Wind Exposure - sheltered
Drainage - moderate
Volume - 270 m3/ha (30 cd/ac)
Trees per hectare - 2500
Site Class - 5

Field Notes: - good to excellent form and quality
- reasonably flat ground

Recommendations:

STAND #2

Species	Percentage Composition	Age (yr.)	Height (m)	Diameter (cm)
White Pine	70	28	9(30')	10(4")
Red Spruce	30	28	9(30')	8(3")

Wind Exposure - light
Drainage - well drained to dry

Volume - 126 m3/ha (14 cd/ac)
Trees per hectare - 10,000
Site Class - 6

Field Notes: - some white pine (10%) have been damaged by white pine weevil
- these trees are of fair to poor quality

Recommendations:

STAND #3

Species	Percentage Composition	Age (yr.)	Height (m)	Diameter (cm)
Red Maple	40	15	7(23')	3(1")
Balsam Fir	30	15	5(16')	1(.4")
Red Spruce	10	15	5(16')	1(.4")
White Pine	10	15	5(16')	1(.4")
Eastern Hemlock	10	15	4(13')	1(.4")

Wind Exposure - light
Drainage - well drained
Volume - 0
Trees per hectare - 15,000
Site Class - 5

Field Notes: - many surface boulders
- red maple are stump suckers
- even distribution of all species throughout stand
- hardwood suppress softwood in many areas

Recommendations:

STAND #4

Species	Percentage Composition	Age (yr.)	Height (m)	Diameter (cm)
Balsam Fir	30	50	16(52')	16(6")
Red Spruce	30	50	16(52')	16(6")
Red Maple	30	50	16(52')	16(6")
Yellow Birch	10	50	16(52')	14(5")

Wind Exposure - moderate
Drainage - well drained to spots of imperfect
Volume - 338 m3/ha (37 cd/ac)

Trees per hectare - 2000
Site Class - 6

Field Notes: - good form and quality trees

Recommendations:

STAND #5

Species	Percentage Composition	Age (yr.)	Height (m)	Diameter (cm)
Red Spruce	50	20	6(20')	4(2")
White Pine	10	20	6(20')	4(2")
Balsam Fir	10	20	6(20')	4(2")
Yellow Birch	10	20	6(20')	4(2")
White Birch	10	20	6(20')	4(2")
Red Maple	10	20	8(26')	4(2")

Wind Exposure - moderate to light
Drainage - well drained
Volume -
Trees per hectare - 10,000
Site Class - 5

Field Notes: - south side of stand has a steep slope facing south
- remainder of stand is relatively flat
- red maple are primarily stump suckers
- all volume is in trees that were left standing during the clearcut

Recommendations:

STAND #6

Species	Percentage Composition	Age (yr.)	Height (m)	Diameter (cm)
Red Spruce	80	40	11(36')	14(5.5")
Balsam Fir	10	40	11(36')	14(5.5")
Red Maple	10	40	11(36')	14(5.5")

Wind Exposure - moderate to exposed
Drainage - well drained
Volume - 270 m3/ha (30 cd/ac)
Trees per hectare - 2800
Site Class - 5

Field Notes: - good to excellent form and quality
- scattered granite boulders
- side of large kill

Recommendations:

STAND #7

Species	Percentage Composition	Age (yr.)	Height (m)	Diameter (cm)
Balsam Fir	30	10	3(10')	2(1")
Red Spruce	30	10	3(10')	2(1")
White Pine	10	10	3(10')	2(1")
Beech	10	10	3(10')	2(1")
Grey Birch	10	10	3(10')	2(1")
Red Maple	10	10	4(13')	2(1")

Wind Exposure - light
Drainage - well drained
Volume - 0
Trees per hectare - 10,000
Site Class - 5

Field Notes: - some porcupine damage to all species
- red maple are stump suckers
- softwoods appear to be of good quality
- hardwoods are of poor quality

Recommendations:

STAND #8

Species	Percentage Composition	Age (yr.)	Height (m)	Diameter (cm)
Red Spruce	30	35	10(33')	8(3")
Balsam Fir	30	35	10(33')	8(3")
White Pine	20	35	10(33')	8(3")
White Birch	10	35	10(33')	8(3")
Red Maple	10	35	19(33')	8(3")

Wind Exposure - moderate
Drainage - well drained
Volume -
Trees per hectare - 15,000
Site Class - 6

Field Notes: - trees are in excellent form

Recommendations:

STAND #9

Species	Percentage Composition	Age (yr.)	Height (m)	Diameter (cm)
Red Spruce	100	45	10(33')	10(4")

Wind Exposure - sheltered
Drainage - imperfect to poor
Volume -
Trees per hectare - 10,000
Site Class - 3

Field Notes: - good form

Recommendations:

SUGGESTED RECOMMENDATIONS

STAND #1

Considering the high concentration of balsam fir and the age, no treatment should be done on this stand. Reassess in 6 to 10 years for harvesting.

STAND #2

A premerchantable thinning should be done to favour good quality white pine and red spruce at a 3 to 4 m spacing.

STAND #3

A cleaning is recommended to favour red spruce, white pine and eastern hemlock. Overtopping hardwoods should be completely removed unless there are no better quality trees present. Space trees to approximately a 2m spacing.

STAND #4

A merchantable thinning is recommended to favour red spruce and yellow birch then red maple at a 3 to 4m spacing. Try to remove as much balsam fir as possible since it is mature now and will probably fall down before the next harvest operation.

STAND #5

A cleaning is recommended to favour the growth of good quality red spruce, white pine and yellow birch at a 2m spacing. Girdle or cut down scattered residuals.

STAND #6

A merchantable thinning is recommended to favour red spruce at a 3m spacing. It may be wise to retain the better quality hardwoods to maintain the windfirmness of this stand.

STAND #7

A cleaning is recommended to favour red spruce, white pine then balsam fir, red maple and beech if necessary. Cut to favour single stemmed trees over sucker growth. Space trees at approximately 2m.

STAND #8

A premerchantable thinning is recommended to favour red spruce, white pine then balsam fir and red maple if necessary. Favour good quality trees at a 2.5 to 3.0m spacing.

STAND #9

No treatment is recommended due to the poor site class. Trees are growing too slow to warrant doing a treatment.

ANSWERS TO QUIZ QUESTIONS

Lesson 1:

1. True
2. True
3. False
4. True
5. False
6. True
7. True
8. True
9. True
10. True

Lesson 2:

1. True
2. True
3. True
4. True
5. True
6. False
7. False
8. True
9. True
10. True

Lesson 3:

1. True
2. True
3. True
4. False
5. True
6. False
7. False
8. True
9. False
10. True